

### HW #3, Problem 1: Steps to calculate luminosities and colors for the model galaxies.

1. Work out the B and V absolute magnitude of each type of star:  $M_B = M_V + (B - V)$ .
2. Calculate the B and V luminosities (in  $L_{B,\odot}$  and  $L_{V,\odot}$ ) of each star type using the absolute magnitudes of the Sun:  
$$M_{B,*} - M_{B,\odot} = -2.5 \log(L_{B,*}/L_{B,\odot})$$
$$M_{V,*} - M_{V,\odot} = -2.5 \log(L_{V,*}/L_{V,\odot})$$
3. Given  $L_{V,tot}$  for the galaxy, and the fraction of V light coming from each type of star ( $f_{V,*}$ ), figure out how much total V light each star type is contributing:  $L_{V,tot,*} = f_{V,*} \times L_{V,tot}$

4. Knowing the individual V luminosity of each star type, you can work out how many stars of that type you need:

$$N_* = L_{V,tot,*} / L_{V,*}$$

5. Work out the total stellar mass by adding up all the mass:  $\mathcal{M}_{*,tot} = \sum N_* \times \mathcal{M}_*$ , then use that to calculate the V-band mass-to-light ratio:  $(\mathcal{M}/L)_{*,tot,V} = \mathcal{M}_{*,tot} / L_{V,tot}$ .

6. Knowing how many of each type of star you have, you can also work out the amount of total B light they are putting out:

$$L_{B,tot,*} = N_* \times L_{B,*}$$

7. Add up all the  $L_{B,tot,*}$  for each type of star to get the total B luminosity of the galaxy:

$$L_{B,tot} = \sum L_{B,tot,*}$$

8. Work out the total absolute B and V mags of the galaxy using

$$M_{B,tot} - M_{B,\odot} = -2.5 \log(L_{B,tot}/L_{B,\odot})$$

$$M_{V,tot} - M_{V,\odot} = -2.5 \log(L_{V,tot}/L_{V,\odot})$$

9. Work out the galaxy's total color from the absolute magnitudes:

$$(B - V)_{tot} = M_{B,tot} - M_{V,tot}$$

**Important:**

Never mix B and V mags and luminosities in one equation! In other words, don't do anything that looks like this:

$$M_B - M_V = -2.5 \log(L_B/L_V)$$

